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by Lisa-Anne Elvidge Munene, Lydia Dumais, Krista Esslinger, Elaine Jones-Mclean, Elizabeth Mansfield, Marie-France Verreault, Maya Villeneuve, Doris Miller and Sylvie St-Pierre

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x suppressed to meet the confidentiality requirements of the *Statistics Act*
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A surveillance tool to assess diets according to Eating Well with Canada's Food Guide

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Abstract

Background: A surveillance tool was developed to assess dietary intake collected by surveys in relation to *Eating Well with Canada's Food Guide* (CFG). The tool classifies foods in the Canadian Nutrient File (CNF) according to how closely they reflect CFG. This paper describes the validation exercise conducted to ensure that CNF foods determined to be "in line with CFG" were appropriately classified.

Methods: With statistical modelling, 8,000 simulated diets (500 for each of the 16 Dietary Reference Intake [DRI] age/sex groups) were generated using commonly consumed foods classified as "in line with CFG." Criteria for assessing the energy content and nutrient distributions of the simulated diets were based on factors considered in the development of CFG, including Estimated Energy Requirement (EER) and Dietary Reference Intake (DRI) values.

Results: The median energy content of the simulated diets was at or below reference EERs. Most age/sex group distributions had macronutrient profiles that met the assessment criterion of 80% of the distribution within the Acceptable Macronutrient Distribution Range, and almost all age/sex group distributions had a low prevalence (less than 10%) of micronutrient profiles below the Estimated Average Requirements. Overall, the findings indicate that diets consisting of foods that are commonly consumed by Canadians and that are "in line with CFG" have a low probability of energy excess and nutrient inadequacy.

Interpretation: The classification of foods in the CNF accurately reflects CFG recommendations and can be used to assess surveillance data.

Keywords: Canada's Food Guide, dietary guidance, food classification system, nutrition surveys, surveillance

The Canadian Nutrient File (CNF), Canada's standard reference food composition database, is used to analyze data collected by food consumption and nutrition surveys. The 2004 Canadian Community Health Survey (CCHS) was the most recent survey to collect food consumption data for Canada. Based on these data, the diets of Canadians have been assessed in relation to recommendations in *Eating Well with Canada's Food Guide* (CFG).[1-7] However, the methods researchers have applied to identify foods consistent with CFG have differed.

Health Canada has designed a surveillance tool to become the standard for this type of analysis. The tool, which categorizes foods in the CNF according to CFG, is referred to as the CNF/CFG Classification.[8]

Foods in the CNF were divided into food groups/subgroups and modelling groups (Text table 1). Foods in the four major CFG groups were then assigned to one of four tiers according to how closely they align with CFG (Text table 2). Tier assignment was based on thresholds set for total fat, saturated fat, sugar and sodium. Adjustments were made to take CFG recommendations into account. The objective was to determine if the CNF/CFG Classification accurately reflects CFG guidance.

Foods "in line with CFG" were then used to create simulated diets. The energy content and nutrient distributions of these diets were assessed against criteria used to model the CFG eating pattern. The CNF/CFG Classification was considered satisfactory when the criteria were met, or when distributions were similar to those of the CFG modelling.

Methods

For each of the 16 Dietary Reference Intake (DRI) age/sex groups (population age 2 or older), 500 simulated diets were created using the CFG modelling groups. This resulted in 8,000 diets that conformed with CFG. Within these modelling groups, only foods "in line with CFG" were used to create the diets. The probability of foods being selected was based on their popularity within each DRI age/sex group and modelling group. The popularity of foods was determined from data from the first 24-hour recall of the 2004 CCHS–Nutrition (31,000 respondents).[9]

Pre-tests calculated the number of diets needed to perform the modelling of CFG. These tests revealed that 500 diets were sufficient—results were similar when more diets were modelled. Balanced Repeated Replication methods were used to calculate the variance of the estimates. The reliability of estimates was assessed using coefficient of variation (CV) thresholds. Most CVs were less than 16.6%, indicating acceptable reliability.

Based on the simulated diets, distributions of energy (kilocalories), macronutrients (carbohydrates, protein and fat) and selected micronutrients (vitamins and minerals) were generated for each DRI age/sex group. The bootstrap percentile method[10] was used to obtain 95% confidence intervals. For each age/sex group, 500 bootstrap samples were generated from the original 500 diets. The distributions of energy and 25 nutrients from the simulated diets were assessed against the following criteria[11]:

Authors: Lisa-Anne Elvidge Munene, Krista Esslinger, Doris Miller and Sylvie St-Pierre are with the Office of Nutrition Policy and Promotion, Health Products and Food Branch, and Lydia Dumais, Elizabeth Mansfield, Marie-France Verreault and Maya Villeneuve are with the Bureau of Nutritional Sciences, Food Directorate at Health Canada. Elaine Jones-Mclean is with the Health Promotion and Chronic Disease Prevention Branch, Social Determinants and Science Integration Directorate at the Public Health Agency of Canada.

- **Median energy** (kilocalories) content of the simulated diets should be at or below the calculated median reference Estimated Energy Requirements (EER) for individuals with a sedentary level of activity. Measured height and weight from the 2004 CCHS–Nutrition were used to determine median height and median normal weight for each age/sex group.
- **For macronutrients** (carbohydrates, protein and fat), 80% of the simulated diets should be within the Acceptable Macronutrient Distribution Range (AMDR).
- **For nutrients without DRI levels,** the following benchmarks were used for the median nutrient content of the simulated diets:
  - less than 10% of total energy (kilocalories) from saturated fatty acids[12]
  - less than 300 mg of dietary cholesterol[13]
  - monounsaturated fatty acids can range up to 20% of total energy[14]
  - polyunsaturated fatty acids can range up to 10% of total energy[14]
- **For micronutrients with an Estimated Average Requirement (EAR)** (vitamin A, thiamin (B1), riboflavin (B2), niacin (B3), B6, folate (B9), B12, vitamins C and D, calcium, iron, magnesium, phosphorous, and zinc), fewer than 10% of the simulated diets should have less than the EAR.
- **For nutrients with an Adequate Intake (AI)** (fibre, alpha-linolenic acid, linoleic acid, potassium), the median nutrient content of the simulated diets should approximate the AI.

Text table 1
Classification of foods into food groups, subgroups and modelling groups (for statistical validation)

Food group	Subgroup	Modelling group (used to create simulated diets)
Vegetables and Fruit[†]	Vegetables, dark green	Vegetables, dark green
	Vegetables, deep yellow or orange	Vegetables, deep yellow or orange
	Vegetables, potatoes	Vegetables, potatoes
	Vegetables, other	Vegetables, other (includes juice)
	Vegetables, juice and cocktail	
	Fruit, other than juice	Fruit (includes juice)
	Fruit, juice	
Grain Products[†]	Grain products, whole-grain	Grain products, whole-grain
	Grain products, non-whole-grain, enriched	Grain products, non-whole-grain
	Grain products, non-whole-grain, not enriched	
Milk and Alternatives[†]	Fluid milk and fortified soy-based beverages	Fluid milk and fortified soy-based beverages
	Other milk and alternatives	Other milk and alternatives
Meat and Alternatives[†]	Beef, game and organ meats	Meats (beef, game, organ meats, pork, veal, lamb, poultry and processed meats)
	Other meats (pork, veal, lamb)	
	Poultry	
	Processed meats	
	Fish	Fish
	Shellfish	Not modelled
	Legumes	Legumes
	Nuts and seeds	Not modelled
	Eggs	Eggs
Other foods and beverages recommended in CFG	Unsaturated fats and oils	Unsaturated fats and oils
	Water	Not modelled
Other foods and beverages not in CFG food groups	Saturated and/or trans fats and oils	Not modelled
	Beverages	Not modelled
	Uncategorized, such as unprepared mixes, dehydrated and condensed soups, spices, herbs, condiments, foods usually eaten in small quantities (not enough to contribute to a CFG serving)	Uncategorized
	Alcoholic beverages	Not modelled
	High-fat and/or high-sugar foods	Not modelled
Foods and beverages not classified	Recipes	Not modelled
	Foods not classified (missing nutrient data)	Not modelled

[†] major food groups of Canada's Food Guide (CFG)
Note: Shaded modelling groups not included in the final validation exercise because they were not included in the final CFG dietary pattern, except for shellfish. In CFG dietary pattern modelling, fresh and processed fish and shellfish were modelled together owing to the nature of the database available at the time.

- **For nutrients with a Tolerable Upper Intake Level (UL)** (vitamins B6, C and D, calcium, iron, phosphorus, zinc, and sodium), none of the simulated diets should have nutrient content at or above the UL. Nutrients with ULs that can only be applied to intake from supplemental sources (magnesium, vitamin A, niacin and folate) were excluded.

These criteria are the same as those used in the CFG modelling,[15] except for calcium and vitamin D, for which the DRIs have since changed.[16] If the criteria were not met, the similarity of the distributions to those obtained in 2007 was verified. When the distributions were similar, the validation results were considered to be satisfactory.

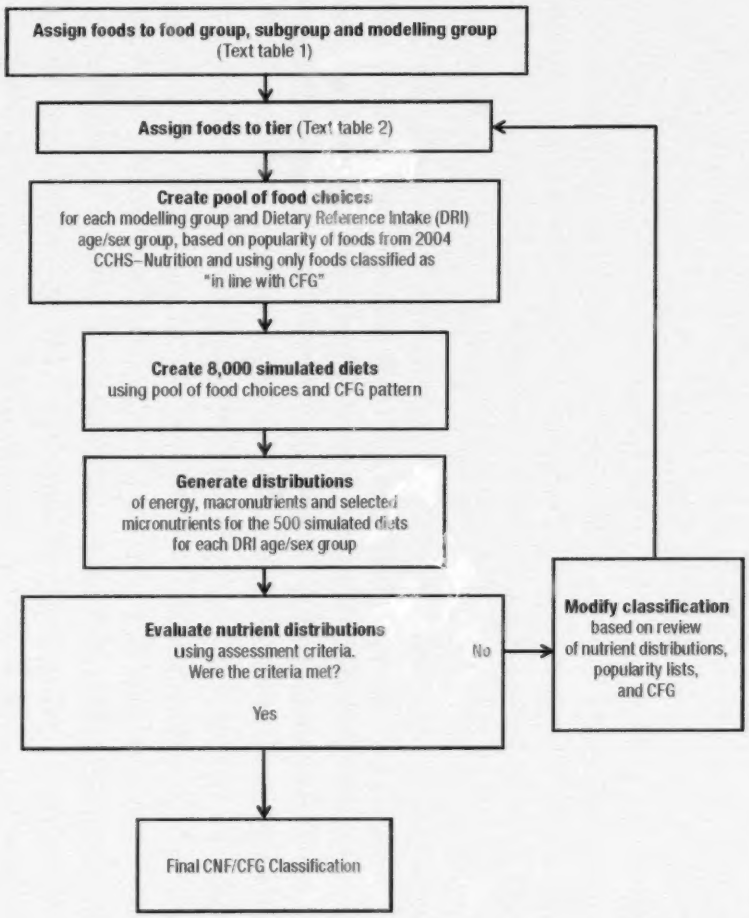
An iterative process was applied to adjust the CNF/CFG Classification to obtain results that were as close as possible to the above criteria while following CFG (Figure 1). Only the energy and nutrient distributions reflecting the results of the final classification are presented here. All analyses were conducted with SAS, version 9.2 (SAS Institute, Inc).

Text table 2
Tiers from the classification of foods in Canadian Nutrient File according to Eating Well with Canada's Food Guide (CNF/CFG Classification)

Tier	Description	Explanation
1 and 2	In line with CFG	Generally lower in fat, sugar or salt. Most choices should come from these foods.
3[1]	Partially in line with CFG	Usually high in one of: fat, sugar or salt. Few choices should come from these foods.
4[1]	Not in line with CFG	Generally high in at least two of: fat, sugar or salt. Foods to limit.

[1] not included in validation exercise because foods are not "in line with CFG"

Figure 1
Validation of CNF/CFG Classification (adapted from Katamay et al.[15])


Assign foods to food group, subgroup and modelling group
(Text table 1)
Assign foods to tier (Text table 2)
Create pool of food choices
for each modelling group and Dietary Reference Intake (DRI) age/sex group, based on popularity of foods from 2004 CCHS–Nutrition and using only foods classified as "in line with CFG"
Create 8,000 simulated diets
using pool of food choices and CFG pattern
Generate distributions
of energy, macronutrients and selected micronutrients for the 500 simulated diets for each DRI age/sex group
Evaluate nutrient distributions
using assessment criteria.
Were the criteria met?
No
Yes
Modify classification
based on review of nutrient distributions, popularity lists, and CFG
Final CNF/CFG Classification

Results

Energy, macronutrients, and nutrients without Dietary Reference Intakes (DRI)

The median energy content (kilocalories) of the simulated diets, which were comprised of foods "in line with CFG," was either within or below the calculated median reference EERs for all age/sex groups except women aged 71 or older (Figure 2).

For carbohydrates, protein and total fat, the distributions for most age/sex groups met the assessment criterion that more than 80% of the simulated diets should be within the AMDRs (Table 1). For protein and carbohydrates, the simulated diets met the criterion, except for children aged 2 to 3. Almost half of the diets for 2- to 3-year-olds exceeded the AMDR for protein, and about a third were below the AMDR for carbohydrates. For total fat, the distributions for children and youth (ages 2 to 18) did not meet the assessment criterion, principally because of the low fat content of the simulated diets. Similarly, distributions for women aged 19 to 70 did not meet the criterion because of low fat content.

For nutrients with no DRI, all the distributions met the assessment criteria. Median cholesterol content ranged from 89 mg to 217 mg. Median saturated fatty acid content ranged from 5% to 8% of total energy. Monounsaturated and polyunsaturated fatty acids ranged, respectively, from 9% to 15% and from 6% to 9% of total energy.

Micronutrients assessed using Estimated Average Requirement (EAR)

Eight of the 14 micronutrients met the assessment criteria of less than 10% of simulated diets below the EAR for all age/sex groups (Table 2). The six micronutrients that did not meet the assessment criteria for at least one age/sex group were vitamins C and D, magnesium, zinc, iron, and calcium.

For vitamin C, magnesium, zinc and iron, the prevalence of inadequate nutrient content was only slightly above 10% in a few age/sex groups. For calcium, the diets of five age/sex groups did not meet the EAR assessment criteria. The vitamin D content of the simulated diets did not meet the assessment criteria for any age/sex group. However, CFG recommends a daily 10µg (400IU) vitamin D supplement for people older than 50, which was added to the vitamin D content of the simulated diets for this population group. As a result, the percentage of diets with a vitamin D content below the EAR was acceptable (data not shown).

Nutrients assessed using Adequate Intake (AI)

For linoleic acid, alpha-linolenic, potassium and fibre, the median content of the simulated diets should approximate the AI. Except for linoleic acid values in the simulated diets of children aged 2 to 3 and fibre for women aged 31 to 50, all the age/sex group median values were below the AI (Table 3).

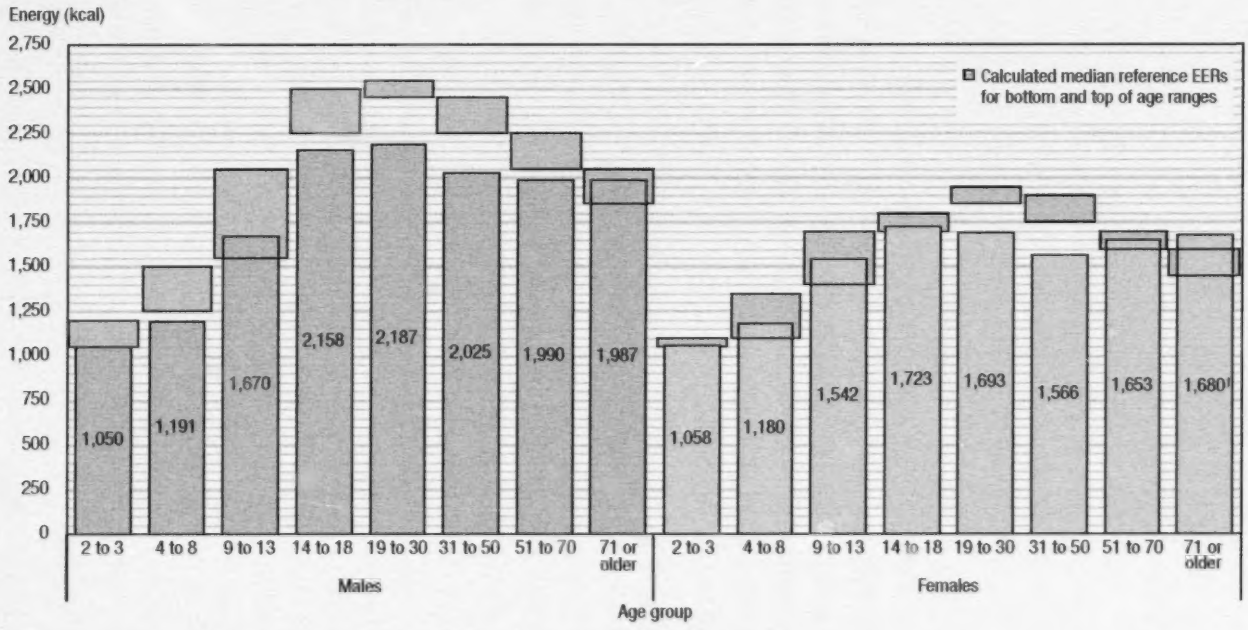
Nutrients assessed against Tolerable Upper Intake Level (UL)

The percentage of the simulated diets with sodium content above the UL ranged widely from 3% to 51% (Table 3). With the exception of calcium and zinc, the nutrient content of simulated diets was below the UL for all other nutrients (data not shown). One percent of diets exceeded the UL for calcium in people aged 51 to 70, and 10% of diets exceeded the UL for zinc in children aged 2 to 3.

Discussion

These results show that the energy content and nutrient distributions of diets based on the CFG dietary pattern and comprised of foods "in line with CFG" are satisfactory.

Figure 2
Median energy content of 500 simulated diets for each age/sex group



† median energy content of simulated diets exceeds calculated median reference Estimated Energy Requirement (EER).

Table 1
Percentage of 500 simulated diets with median percent of energy from protein, carbohydrate and fat within Acceptable Macronutrient Distribution Ranges (AMDRs), by sex and age group

Macronutrient, sex, age group	Median % of energy	AMDR (%)	Within AMDR			% below AMDR	% above AMDR
			%	95% confidence interval from	to		
Protein							
Male							
2 to 3	18.9	5 to 20	58†	54	63	0	41.6
4 to 8	18.3	10 to 30	greater than 98			0	0
9 to 13	22.0	10 to 30	greater than 98			0	0
14 to18	22.8	10 to 30	greater than 98			0	0.8
19 to 30	20.5	10 to 35	greater than 98			0	0
31 to 50	21.5	10 to 35	greater than 98			0	0
51 to 70	22.5	10 to 35	greater than 98			0	0
71 or older	22.2	10 to 35	greater than 98			0	0
Female							
2 to 3	19.6	5 to 20	55†	50	59	0	45.4
4 to 8	18.5	10 to 30	greater than 98			0.2	0
9 to 13	18.0	10 to 30	greater than 98			0	0
14 to 18	21.3	10 to 30	greater than 98			0	0.8
19 to 30	19.3	10 to 35	greater than 98			0	0
31 to 50	20.6	10 to 35	greater than 98			0	0
51 to 70	21.5	10 to 35	greater than 98			0	0
71 or older	20.6	10 to 35	greater than 98			0	0
Carbohydrate							
Male							
2 to 3	47.5	45 to 65	66†	62	71	33.2	0.4
4 to 8	51.6	45 to 65	greater than 84			9.8	2.6
9 to 13	53.0	45 to 65	greater than 84			2.4	0.4
14 to 18	50.6	45 to 65	greater than 84			6.6	0
19 to 30	53.9	45 to 65	greater than 84			0.2	0.8
31 to 50	52.4	45 to 65	greater than 84			2.6	0.4
51 to 70	50.5	45 to 65	greater than 84			9.6	0.2
71 or older	50.6	45 to 65	greater than 84			6.6	0
Female							
2 to 3	46.8	45 to 65	60†	55	64	39.6	0.8
4 to 8	50.7	45 to 65	greater than 84			10.8	1.8
9 to 13	57.3	45 to 65	greater than 84			0.4	9.8
14 to 18	55.0	45 to 65	greater than 84			1.4	0.6
19 to 30	57.6	45 to 65	greater than 84			0.4	4.8
31 to 50	54.3	45 to 65	greater than 84			2.8	1.6
51 to 70	54.4	45 to 65	greater than 84			2.2	1.4
71 or older	55.1	45 to 65	greater than 84			0.6	0.6
Fat							
Male							
2 to 3	34.6	30 to 40	58†	54	62	26.8	15.2
4 to 8	30.9	25 to 35	64†	60	68	20.2	15.6
9 to 13	25.1	25 to 35	51†	47	56	48.8	0
14 to 18	26.7	25 to 35	66†	62	70	33.8	0.4
19 to 30	25.8	20 to 35	84 or greater			12.6	0.4
31 to 50	26.1	20 to 35	84 or greater			10.4	0.8
51 to 70	27.2	20 to 35	84 or greater			7.4	1.2
71 or older	27.4	20 to 35	84 or greater			6.6	0.8
Female							
2 to 3	35.0	30 to 40	60†	56	64	25.8	14.4
4 to 8	31.7	25 to 35	66†	62	70	15.0	19.0
9 to 13	24.8	25 to 35	48†	44	52	51.4	0.4
14 to 18	23.8	25 to 35	38†	34	43	61.8	0.2
19 to 30	23.3	20 to 35	72†	68	75	28.2	0.2
31 to 50	25.1	20 to 35	80†	77	83	19.0	0.8
51 to70	24.4	20 to 35	80†	76	84	20.0	0
71 or older	24.7	20 to 35	84	80	87	16.2	0

† fewer than 80% of simulated diets within AMDR

Energy, macronutrients, and nutrients with no Dietary Reference Intake (DRI)

The median energy (kilocaloric) content of the simulated diets was generally close to EER reference values, except for women aged 71 or older (slightly above reference median). These results were acceptable, given the small excess and the substantial variability in the calculated EER values. For instance, the 95% confidence interval of the equation for adult women is ±320 kilocalories,[14] an indication of how variable energy requirements can be among people with similar characteristics. As well, EER values were calculated based on a sedentary level of activity, whereas CFG recommends physical activity.

The protein content of more than 40% of the simulated diets for children aged 2 to 3 was above the AMDR. However, these results were satisfactory, given the rationale behind the establishment of the AMDR for protein. The recommended protein range was set to complement the AMDRs for fat and carbohydrates, and data were insufficient to establish a UL.[14]

Substantial percentages of the simulated diets for children and youth aged 2 to 18 were below the AMDR for total fat. Even so, most studies have reported that the level of dietary fat has no effect on growth when energy intake is adequate.[14] Therefore, because the energy content of the diets for 2- to 18-year-olds was close to the reference EER values, the results for total fat were satisfactory.

For adults, no EAR or AI could be set for total fat, because data were insufficient to determine a level at which a risk of inadequacy or the prevention of chronic disease occurs.[14] Consequently, the simulated diets of women aged 19 to 70 were considered acceptable although the criteria were not met.

The results for cholesterol and for saturated, monounsaturated and polyunsaturated fatty acids all met the assessment criteria.

Table 2
Percentage of 500 simulated diets with micronutrient content below Estimated Average Requirement (EAR), by sex and age group

Sex and age group	Folate			Magnesium			Niacin			Phosphorus			Riboflavin			Thiamin			Vitamin D[2]		
	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to
Male																					
2 to 3	3.0	1.6	4.4	0	...	...	0	...	...	0	...	...	0	...	...	0	...	...	93.0[†]	90.0	95.0
4 to 8	1.2	0.4	2.2	0	...	...	0	...	...	0	...	...	0	...	...	0	...	...	92.5[†]	89.6	94.6
9 to 13	1.8	0.8	3.0	0	...	...	0	...	...	0	...	...	0	...	...	0	...	...	85.8[†]	82.4	88.6
14 to 18	0.8	0.2	1.6	5.0	3.0	7.0	0	...	...	0	...	...	0	...	...	0	...	...	79.2[†]	75.8	85.6
19 to 30	0.2	0.0	0.6	1.0	0.2	2.0	0	...	...	0	...	...	0	...	...	0	...	...	82.4[†]	78.8	85.6
31 to 50	0.0	...	...	7.2	4.8	9.6	0	...	...	0	...	...	0	...	...	0	...	...	69.8[†]	65.6	73.8
51 to 70	1.4	0.4	2.6	13.2[†]	10.4	16.0	0	...	...	0	...	...	0	...	...	0	...	...	62.2[†]	58.0	66.6
71 or older	2.4	1.0	3.6	12.6[†]	9.6	15.8	0	...	...	0	...	...	0	...	...	0	...	...	53.2[†]	48.2	57.6
Female																					
2 to 3	3.4	2.0	5.2	0	...	...	0	...	...	0	...	...	0	...	...	0.2	0	0.6	89.4[†]	86.6	92.0
4 to 8	0.8	0.2	1.8	0	...	...	0	...	...	0	...	...	0	...	...	0	...	...	93.8[†]	91.6	95.8
9 to 13	1.0	0.2	2.0	0.2	0	0.6	0	...	...	1	0.2	2.0	0	...	...	0	...	...	80.0[†]	76.6	83.8
14 to 18	4.6	2.8	6.6	9.0[†]	6.6	11.6	0	...	...	0	...	...	0	...	...	0	...	...	90.0[†]	87.4	92.4
19 to 30	4.4	2.8	6.4	0.2	0	0.6	0	...	...	0	...	...	0	...	...	0	...	...	87.0[†]	84.2	89.4
31 to 50	6.8	4.4	9.2	3.4	2.0	5.2	0	...	...	0	...	...	0	...	...	0	...	...	83.6[†]	80.6	87.0
51 to 70	4.6	2.8	6.2	1.0	0.2	2.0	0	...	...	0	...	...	0	...	...	0	...	...	79.4[†]	75.8	82.8
71 or older	4.8	3.0	6.8	1.0	0.2	2.0	0	...	...	0	...	...	0	...	...	0	...	...	72.0[†]	68.4	76.2

Sex and age group	Vitamin A			Vitamin B12			Vitamin B6			Vitamin C			Zinc			Iron[§]			Calcium		
	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to	%	95% confidence interval from	to
Male																					
2 to 3	0	...	...	0	...	...	0	...	...	0.0	...	...	0.0	...	...	6.6	...	...	0	...	...
4 to 8	0	...	...	0	...	...	0	...	...	0.0	...	...	0.2	0.0	0.8	6.3	...	...	26.6[†]	23.0	30.4
9 to 13	0	...	...	0	...	...	0	...	...	0.8	0.2	1.6	0.6	0.0	1.4	0.1	...	...	8.6[†]	6.2	11.0
14 to 18	0.4	0.0	1.0	0	...	...	0	...	...	0.6	0.0	1.4	0.2	0.0	0.6	0.2	...	...	4.6	2.8	6.4
19 to 30	2.4	1.2	3.8	0	...	...	0	...	...	0.0	...	...	7.0	4.8	9.4	0	...	...	0.4	0.0	1.0
31 to 50	0.8	0.2	1.6	0.8	0.2	1.8	0	...	...	4.4	2.6	6.4	10.4[†]	7.8	13.2	0	...	...	1.0	0.2	2.0
51 to 70	1.2	0.4	2.2	0	...	...	0.4	0	1.0	7.2	4.8	9.6	2.8	1.6	4.4	0	...	...	0	...	...
71 or older	2.2	1.0	3.6	0	...	...	0	...	...	11.2[†]	8.8	14.0	3.6	2.2	5.2	0	...	...	2.6	1.2	4.2
Female																					
2 to 3	0	...	...	0	...	...	0	...	...	0.2	0	0.6	0	...	...	6.5	...	...	0	...	...
4 to 8	0	...	...	0	...	...	0	...	...	0	...	...	0.8	0.2	1.6	7.1	...	...	33.0[†]	29.2	37.2
9 to 13	0.4	0	1.0	0	...	...	0.2	0	0.6	0.8	0.2	1.6	12.0[†]	9.4	15	0.5	...	...	10.8[†]	8.2	13.4
14 to 18	0	...	...	0	...	...	0	...	...	0.2	0	0.6	1.4	0.4	2.4	5.7	...	...	14.6[†]	11.4	17.6
19 to 30	0.6	0	1.2	1.8	0.8	3.0	0	...	...	0.8	0.2	1.6	2.2	1.0	3.6	7.7	...	...	2.2	1.0	3.6
31 to 50	0	...	...	1.2	0.4	2.2	0	...	...	5.6	3.6	7.6	8.2[†]	6.0	10.4	12.1[†]	...	...	2.2	1.0	3.6
51 to 70	0.4	0	1.2	0.2	0	0.8	1.4	0.4	2.4	4.0	2.2	5.8	0.2	0	0.8	0	...	...	6.4	4.4	9.0
71 or older	0.4	0	1.0	0	...	...	0.8	0.2	1.6	5.2	3.4	7.2	0	...	...	0	...	...	2.6	1.2	4.2

[†] more than 10% prevalence of inadequate nutrient content
[‡] inadequate vitamin D from food alone must be interpreted with caution; vitamin D from supplements, as CFG recommends for people older than 50, not added to simulated diets
[§] full probability method used in assessment of iron content
... not applicable

Micronutrients assessed using Estimated Average Requirement (EAR)

Most simulated diets met the assessment criteria of the 14 micronutrients with EARs. Of the six micronutrients with inadequacies—vitamins C and D, magnesium, zinc, iron, and calcium—four had distributions where the 10th percentile was only slightly below the EAR. Because the shortfalls were relatively small and did not occur in just one age/sex group (no consistent pattern), the distributions were all considered to satisfy the assessment criteria.

For iron, 12% of the simulated diets of women aged 31 to 50 were below the EAR, while the prevalence of inadequate iron content was low for this age/sex group in the CFG modelling.[15] Further analysis showed that this difference likely came from changes in

Table 3
Median nutrient content (nutrients with an AI or UL) of 500 simulated diets, by sex and age group

Sex and age group	Alpha-Linolenic acid		Linoleic acid		Potassium		Fibre		Sodium‡	
	Median nutrient content	AI (g/day)	Median nutrient content	AI (g/day)	Median nutrient content	AI (mg/day)	Median nutrient content	AI (g/1,000 kcal)	% of diets above UL	UL (mg/day)
Male										
2 to 3	1.9	0.7	7.0	7	2,075†	3,000	10.9†	14	12.0§	1,500
4 to 8	1.9	0.9	7.0†	10	2,309†	3,800	11.6†	14	3.0§	1,900
9 to 13	2.3	1.2	8.5†	12	3,517†	4,500	11.8†	14	18.4§	2,200
14 to 18	3.9	1.6	11.8†	16	4,367†	4,700	10.5†	14	51.2§	2,300
19 to 30	4.4	1.6	12.1†	17	4,391†	4,700	13.4†	14	38.6§	2,300
31 to 50	2.8	1.6	11.1†	17	3,935†	4,700	13.5†	14	32.4§	2,300
51 to 70	2.9	1.6	11.3†	14	3,951†	4,700	12.4†	14	35.6§	2,300
71 or older	2.7	1.6	11.8†	14	3,977†	4,700	12.7†	14	36.0§	2,300
Female										
2 to 3	1.8	0.7	7.2	7	2,085†	3,000	10.6†	14	12.6§	1,500
4 to 8	1.9	0.9	7.3†	10	2,316†	3,800	11.8†	14	5.6§	1,900
9 to 13	1.9	1.0	7.6†	10	3,166†	4,500	11.7†	14	11.6§	2,200
14 to 18	2.2	1.1	8.1†	11	3,680†	4,700	11.5†	14	17.8§	2,300
19 to 30	2.0	1.1	8.1†	12	3,468†	4,700	13.8†	14	9.2§	2,300
31 to 50	2.0	1.1	7.9†	12	3,297†	4,700	14.0	14	6.6§	2,300
51 to 70	2.0	1.1	8.5†	11	3,582†	4,700	13.3†	14	9.8§	2,300
71 or older	2.0	1.1	8.6†	11	3,636†	4,700	13.8†	14	9.8§	2,300

† below Adequate Intake (AI)
‡ assessed against Tolerable Upper Intake Level (UL)
§ does not meet assessment criteria of an absence of simulated diets above Tolerable Upper Intake Level

the popularity of foods used to create the simulated diets of the two modelling exercises. For example, non-iron enriched grain products such as rice became more popular over time. For the CFG modelling, popularity was based on the then-most-recent—1997 to 1999—provincial surveys (Ontario, Manitoba, British Colombia and Quebec), whereas popularity for the present validation was based on the 2004 CCHS–Nutrition. Consequently, the difference in the percentage of diets below the EAR was likely attributable to differences in the popularity of foods, rather than to a lack of iron in foods classified as "in line with CFG." Therefore, slightly less desirable results for this age/sex group were considered acceptable, and further adjustments to the Classification were not undertaken.

For vitamin D, 53% to 93% of the simulated diets were below the EAR. However, when the recommended vitamin D supplement for people older than 50 was added, vitamin D content was satisfactory for these age/sex groups. Median vitamin D values in the validation exercise were similar to those obtained in the modelling of CFG (results not shown). However, the CNF/CFG Classification was assessed against the 2011 EAR for vitamin D,[16] and the 1997 AI value[17] had been used for the modelling of the CFG dietary pattern.[15] The fact that the 2011 EAR is higher than the 1997 AI value explains the high prevalence of simulated diets below the EAR in this validation exercise. Because the Canadian food supply contains few sources of vitamin D, it is unlikely that modifications to the Classification would have affected the vitamin D content of the simulated diets. As well, inadequate vitamin D intake from diet alone should be interpreted in the context of blood levels, which reflect vitamin D from all sources (synthesized from sun exposure; intake from food and supplements). Blood analyses do not suggest widespread vitamin D deficiency in the Canadian population.[18,19] Therefore, failure to meet the 2011 EAR criterion was considered acceptable, and further adjustments were not made to the CNF/CFG Classification.

Nutrients assessed using Adequate Intake (AI)

For nutrients with only an AI, if median nutrient content is below that AI, it should not be assumed that the diets provide an inadequate amount.[11] As was observed with the CFG modelling in 2007, achieving satisfactory linoleic acid, potassium and fibre in the simulated diets is difficult.[15] The benefits of adding more food to the pattern, specifying inclusion of particular subgroups of foods, and adding supplements were weighed against the consequences of an increased risk of nutrient inadequacy or energy excess.[15] Given the limitations surrounding the use of an AI, the assessment of adequacy involved examining the scientific basis for the DRI value for each nutrient, the quality or completeness of the nutrient information in the CNF database (from which diets were created), and the availability of the nutrient in the food supply.

For linoleic acid, median content was below the AI for all age/sex groups except children aged 2 to 3, but no median value

was below 2.5% to 3.5% of total energy, the amount associated with prevention of deficiency.[20] The linoleic acid content of the simulated diets ranged from 4.2% to 6.1% of total energy (data not shown). Therefore, the linoleic acid content of the simulated diets was considered acceptable.

Potassium medians for the simulated diets were slightly lower for most age/sex groups than those accepted in the final modelling for development of the CFG.[15] However, the potassium content of the simulated diets was close to that obtained in CFG modelling. Further, median nutrient content below the AI cannot be assumed to be inadequate because AI values have limited use in assessment.[11] For these reasons, the results were considered satisfactory, and no further adjustments were made to the CNF/CFG Classification.

Median fibre content was the same or higher than the results obtained from the CFG modelling,[15] and thus, considered satisfactory.

Nutrients assessed against Tolerable Upper Intake Level (UL)

The zinc content of the simulated diets of children aged 2 to 3 exceeded the UL at the 90th percentile by a minimal amount (0.2 mg). For calcium, the simulated diets of people aged 51 to 70 exceeded the UL only at the 99th percentile (200 mg to 240 mg). Because these excesses were observed only at the very upper tails of the distributions, the results were considered acceptable. Furthermore, zinc ULs for children were based on limited data, and recent evidence suggests that they may be too low.[21]

For sodium, the assessment criterion (absence of diets with content at or above the UL) was not met for most age/sex groups. Nonetheless, the majority of the simulated diets had sodium content below the UL, considerably better than results from the CFG modelling. Lowering the sodium threshold for foods to be classified as "in line with CFG" would have yielded very restrictive diets.

Limitations and considerations

The use of popular foods in the validation helped ensure that simulated diets reflect what Canadians eat, but it may have yielded some unexpected results. Furthermore, the 1997 version of the CNF was used for the CFG modelling, whereas this validation exercise used the 2001b version of the CNF. Changes in nutrient values of foods over time could have contributed to some of the differences between the two modelling exercises.

This validation involved popular foods as identified in the 2004 CCHS–Nutrition, which used the 2001b CNF database and likely does not reflect the current marketplace. In preparation for the 2015 CCHS–Nutrition, the CNF database is being updated to reflect the availability of foods today.

Conclusions

The simulated diets, which used foods in the CNF/CFG Classification that are "in line with CFG," met the pre-established assessment criteria. The simulated diets had a high probability of nutrient adequacy and macronutrient balance with an appropriate energy content. Therefore, the revised CNF/CFG Classification accurately reflects the dietary recommendations of CFG.

The findings indicate that the CNF/CFG Classification can be used as a surveillance tool to help ensure consistent assessment of Canadians' dietary intake in relation to dietary guidance. This analysis will also inform future nutrition and healthy eating policies and promotion. ■

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What is already known on this subject?

- The modelling process used for the development of Canada's Food Guide (CFG) helped ensure that Canadians who followed the CFG dietary pattern could meet their nutrient goals without exceeding their energy requirements.
- A similar process can be used to validate the classification of foods in the Canadian Nutrient File (CNF) according to CFG.

What does this study add?

- The validation exercise shows that the CNF/CFG Classification reflects CFG.
- In preparation for the analysis of data from the 2015 Canadian Community Health Survey—Nutrition, this surveillance tool will help nutrition and public health researchers consistently assess the diets of Canadians relative to CFG.

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